THE INFLUENCES OF TRAFFIC CALMING DEVICES ON FIRE VEHICLE TRAVEL TIMES

EXECUTIVE DEVELOPMENT

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ABSTRACT

Traffic calming devices are increasingly being used on Portland's neighborhood streets when traffic conditions are out of character with their adjacent residential, institutional, and recreational land uses. Calming devices are used to slow vehicles; to encourage the use of more appropriate streets for through trips; and to enhance pedestrian, bicycle, and transit safety.

The problem is that while traffic calming devices have proven to be an effective way to control neighborhood traffic without significantly impacting convenience, mobility, and travel time for citizens, certain devices affect the speed of various fire vehicles in a way that might cause an increase in overall vehicle response times.

The purpose of this research was to gather information on why communities feel the need for traffic calming, to determine how traffic calming devices affect fire vehicle travel times, and to make recommendations on how to address traffic calming concerns.

The action research method was utilized to address the following questions:

1. Why do communities install traffic calming devices?
2. How do speed bumps and traffic circles affect response times of emergency response vehicles?
3. In addition to the traffic-calming device itself, what other variables affect fire vehicle travel times?

The research considered four variables that influence the speed at which a fire vehicle can be negotiated around traffic circles or across speed bumps. The variables tested were the driver, the typed of fire vehicle, the desirable vehicle speed, and the types of calming devices.

It should be acknowledged that the research results do not, in and of themselves, provide conclusions about when, where, or how to use traffic calming devices. Even with all of the best

possible information, the recommendation is for cities to develop public policies, traffic calming practices, and emergency response strategies that strike a balance between the desire for slower and safer traffic conditions and the desire for prompt emergency response.

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INTRODUCTION

Traffic calming devices are increasingly being used on Portland's neighborhood streets when traffic conditions are out of character with their adjacent residential, institutional, and recreational land uses. Calming devices are used to slow vehicles; to encourage the use of more appropriate streets for through trips; and to enhance pedestrian, bicycle, and transit safety.

The problem is that while traffic calming devices have proven to be an effective way to control neighborhood traffic without significantly impacting convenience, mobility, and travel time for citizens, certain devices affect the speed of various fire vehicles in a way that might cause an increase in overall response times.

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2. How do speed bumps and traffic circles affect response times of emergency response vehicles?
3. In addition to the traffic-calming device itself, what other variables affect fire vehicle travel times?

BACKGROUND AND SIGNIFICANCE

Since the creation of the first automobile, transportation engineers have worked to develop and build a network of roadways that have increased both traffic speeds and volumes. These roadway designs typically involved widening and straightening roads; thereby creating a

roadway environment that feels safe and comfortable for higher speed driving. At the same time that street designs have made higher speed driving more comfortable, improved automobile designs have made cars that are more powerful and maneuverable. Both of these factors contribute and compound the problem of excessive traffic speeds and volumes on residential streets.

As traffic volumes and speeds have increased on residential streets, so have resident complaints to public officials. Beginning in the late 1940's, United States cities such as Montclair, New Jersey, Grand Rapids, Michigan and Richmond, California began traffic claming programs to address citizen concerns. Over the years, the number of cities participating in traffic calming programs has increased to address citizen concerns. Today, traffic calming is part of a national change in the way the transportation system is viewed, as evidenced by the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21).

While the number of traffic calming programs in the United States has grown substantially over the last twenty years, a consensus of what is meant by traffic calming has yet to be reached by transportation professionals. A subcommittee of the International Institute of Transportation Engineers (ITE) offered the following definition published in the July, 1997 ITE Journal:

"Traffic calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users."

Robert Ewing offered another definition that deserves consideration in his presentation at the 1998 ITE Annual Conference in Toronto, Canada. His definition:

"Traffic calming involves changes in street alignment, installation of barriers, and other physical measures to reduce traffic speeds and/or cut-through volumes, in the interest of street safety, livability, and other public purposes."

Despite the fact that a consensus has yet to be reached, both of these definitions express goals of altering motorist behavior, and improving liability and conditions for the non-motorist users of a street.

Studies show traffic calming can reduce vehicle accidents and increase safety for pedestrians and bicyclists (Environmental Working Group [EWG], 1997). A recent study found that "The chance of a pedestrian being killed by an automobile accident increases from 5% at 20 mph to 45% at 30 mph and 85% at 40 mph…." (Pedestrian Federation of America [PFA], 1995). Another study found that between 1986 and 1995, approximately 6,000 pedestrians died every year in the United States after being hit by an automobile. In 1995, 32 percent of all the 5 to 9-year-old children who died in car crashes were pedestrians. Since 1986, 17 percent of all pedestrian fatalities, an average of approximately 1,033 per year, involve children under the age of 18. The average cost to society of a pedestrian-motor vehicle crash is $312,000, or a total of more than $32 billion per year. Over one-third of the bicyclists killed in motor vehicle crashes in 1994 were between 5 and 15 years old (EWG, 1997). The 1997 Surface Transportation Policy Project article, *Mean Streets – Pedestrian Safety and Reform of the Nation's Transportation Law*, reports that in Seattle, the city's traffic calming program reduced pedestrian accidents by more than 75 percent.

Excessive traffic speeds and volumes have been consistently cited by City of Portland residents as one of the greatest threats to feeling comfortable and safe as a non-motorized user of residential streets. This was apparent in 1977 from a citizen survey done as part of the

development of the Arterial Streets Classification Policy (ASCP), and reaffirmed in a 1992 Bureau of Traffic Management (BTM) survey of licensed drivers and the 1993 "Reclaiming Our Streets" Community Action Plan. When asked to name the single most serious traffic safety problem, 37% indicated "people driving too fast in neighborhoods" (Citizens Advisory Committee Report and Recommendations, 1992).

In an effort to improve public safety and neighborhood livability, the Portland Department of Transportation (PDOT) began installing traffic calming devices in 1984. The Portland Bureau of Fire soon began to express concern that traffic calming would slow their emergency response. In Portland, traffic calming is used to reduce speed and traffic volumes, primarily on residential streets. This is done by a variety of techniques, including speed bumps, traffic circles, narrowing lanes, restricting turns, and diverting traffic.

Quick response to a fire or medical emergency is necessary to reduce the loss of life and property. The Portland Fire Bureau's goal is to arrive at a fire or other emergency within four minutes of their notification by the E-911 communication center.

On March 11 and 12, 1991, the Portland Fire Bureau tested a 12-foot wide, 3-inch high speed bump using speeds ranging from 10 to 25 mph. The test included fire apparatus, police patrol cars, Tri-Met buses, private ambulance transport vehicles, City maintenance vehicles, and even a bicyclists. The results of this rather informal and unsophisticated test is summarized in Table 4 of this report.

After years of expressing concerns about fire vehicle travel times, in the Fall of 1995, the Portland Fire Bureau and the City's Department of Transportation conducted a thorough data collection effort to help quantify the relationship between three types of traffic calming devices and their affect on fire vehicle travel times. Different types of fire vehicles were driven on

streets calmed with traffic circles, 14-foot speed bumps, and 22-foot speed bumps. The testing considered four variables that influence the speed at which a fire vehicle can be negotiated around traffic circles or across speed bumps. The variables tested were the driver, the type of fire vehicle, the desirable vehicle speed, and the types of claming devices.

LITERATURE REVIEW

Desire for Traffic Calming

As traffic volumes and speeds have increased on residential streets, so have resident complaints to public officials (Bureau of Traffic Management [BTM], 1993). In an effort to address these complaints, the City of Portland, Oregon began installing traffic calming devices on neighborhood streets in 1984. The installation of traffic calming devices on streets traditionally used by the Portland Fire Bureau for emergency response created a public safety question.

A literature review was conducted to look for any nationally recognized or accepted studies that could explain why citizens desire to have traffic calming devices installed in their communities. The review also attempted to obtain information on the affects that traffic calming has on fire vehicle travel times.

The literature review found studies that show traffic calming can reduce vehicle accidents and increase safety for pedestrians and bicyclists (Pedestrian Federation of America, 1995). The research found that the average cost to society of a pedestrian-motor vehicle crash is more than $32 billion per year (EWG, 1997).

Studies showed that over one-third of the bicyclists killed in motor vehicle crashes in 1994 were between 5 and 15 years old (EWG, 1997).

Traffic Calming Affect on Emergency Response Vehicles

The literature review found limited information on the affect that traffic calming has on fire vehicle travel times. While there is substantial information available to justify the need for traffic calming, the City of Portland appears to be the country's leading authority when it comes to studying the affect that traffic calming has on emergency response.

In 1996, a joint study was conducted by the Portland Fire Bureau (PFB) and the Bureau of Traffic Management (BTM) to evaluate the affect that various traffic calming devices have on fire vehicle travel times. The study, "Influence of Traffic Calming Devices on Fire Vehicle Travel Times", found that depending on the type of fire vehicle, the desirable response speed, and the type of traffic calming device, the delay ranged from 0.0 to 10.7 seconds per device (Tables 1, 2 and 3).

Variables Affecting Fire Vehicle Travel Times

The literature review identified several variables in addition to the traffic-calming device itself that can affect fire vehicle response times. The variables identified included; 1) the driver, 2) the type of fire vehicle, 3) the desirable vehicle speed, and 4) the type of calming device (PFB and BTM, 1996).

Summary

In summary, the review of the literature confirmed that traffic calming programs have become more common throughout the United States as residents begin to complain to their elected officials about increases in both traffic volumes and speeds in their neighborhoods. As the number of traffic calming projects is increased, the emergency response agencies responsible for providing public safety have become more concerned and vocal. The problem is particularly difficult because both services, traffic-calming and emergency response, are needed and

demanded by the public. The trick is to find a balance were both agencies can deliver the greatest amount of good with the smallest amount of tradeoff.

PROCEDURES

Definition of Terms

Emergency Response Vehicles. Employed in responding to emergencies. Examples of emergency response vehicles include fire apparatus, ambulances, and police cars.

Opticom. A signal preemption system for emergency response vehicles.

Traffic Calming. Roadway design strategies to reduce vehicle speeds and volumes aimed at improving traffic safety and neighborhood livability. Traffic calming measures include, but are not limited to traffic slowing devices. Examples of other traffic calming measures are traffic diverters, curb extensions, and medians.

Traffic Slowing Devices. Devices employed that slow emergency response vehicles as well as general traffic. In Portland, the only currently used devices considered to be traffic-slowing devices are speed bumps and traffic circles.

Emergency Response Street Classification Map. The Emergency Response Streets Map identifies Major and Minor Emergency Response Streets. Major Emergency Response Streets were selected based on the following considerations:

- eligibility of streets for traffic slowing devices
- spacing/connectivity
- traffic classifications
- location of fire stations
- topography

Major Emergency Response Streets. Major Emergency Response Streets are intended to serve primarily the longer, most direct legs of emergency response trips. Major Emergency Response Streets are not eligible for traffic slowing devices.

Minor Emergency Response Streets. Minor Emergency Response Streets are intended to serve primarily the shorter legs of emergency response trips. Minor Emergency Response Streets are eligible for traffic slowing devices.

Research Methodology

The desired outcome of this research was to identify why communities desire to install traffic calming devices, to understand how traffic calming devices affect fire vehicle travel times, and to identify other variables that affect fire vehicle travel times.

The research was action research in that the information gathered was used to help solve the problem of increased fire vehicle travel times. The information gathered was used to document the impact that traffic-calming devices have on fire vehicle travel times, and to make recommendations on how communities can address traffic calming concerns.

Although there had been no documented instances where traffic calming devices had caused the Fire Bureau to exceed their response time standard, concerns by the Fire Bureau about traffic calming projects and emergency response routing continued to escalate.

The Fire Bureau and the Department of Transportation continued to work together to resolve issues on a project-by-project basis. Addressing traffic calming on a project-by-project basis proved to be a very time consuming, and the process tended to cause distrust by both sides due to inconsistent policy decisions. While both the Fire Bureau and the Department of Transportation share the goal of protecting and enhancing public safety, it was apparent that there were conflicts about the methods used to achieve the goal.

To better understand the impacts of traffic claming, the Bureau of Traffic Management and the Fire Bureau performed a research project to measure the effects of both traffic circles and speed bumps on response times for various types of fire apparatus during the Fall of 1995. The bureaus conducted a thorough data collection effort to help quantify the relationship between three types of traffic calming devices and fire vehicle travel times. Six different types of fire vehicles were driven on streets calmed with traffic circles, 14-speed bumps, and 22-speed bumps.

The testing considered four variables that influence the speed at which a fire vehicle can be negotiated around traffic circles or across speed bumps. The variables tested were the driver, the type of fire vehicle, the desirable vehicle speed, and the types of calming devices.

The data collection effort involved six fire vehicles of varying characteristics. One fire engine, one transport capable rescue, one heavy squad, and three 100-foot aerial ladder trucks were tested.

Test runs were conducted on a total of six streets. Two streets had 14-foot speed bumps, two had 22-foot speed bumps, and two had traffic circles. A total of 36 different drivers participated in the testing. The total number of test runs on each street was four per vehicle, or 24 runs per street.

Each test run was video taped. The camera recorded the vehicle speeds that were detected and displayed by a radar gun. The time of day, to the nearest second, was superimposed on the recording. The speed and time information for each test run was transcribed from the videotapes to a spreadsheet. The information for each run was used to calculate the distance traveled after each second, as well as the vehicle's distance from the starting line after each of the run.

For various combinations of the four variables, the time needed to travel a length of street that had no calming device was compared to the time needed to travel the same length with a calming device. The time and impact distance required to decelerate from a desirable response speed, negotiate the calming device, and accelerate back to the original speed was determined from the data. The time required to travel the same impact distance without a calming device to influence the desirable response speed was calculated. The difference between the two travel times equals the delay associated with calming device. This delay-per-device was calculated for all six vehicles as they negotiated every calming device on the six test streets. Delays-per-device were calculated for desirable response speeds of 25, 30, 35, and 40 mph.

Assumptions and Limitations

It should be acknowledged that the research results do not provide conclusions about when, where, or how to use traffic claming devices. The results of the research only provide one of the many pieces of information that could help decide where traffic calming strategies might be acceptable.

A major limitation in conducting this research was the inability to find other cities that have conducted similar tests. The researcher was unable to find any other studies that compared the vehicle travel times of fire apparatus negotiating around or over traffic calming devices.

The research did not correlate the fire vehicle travel time and the degree of risk to life and property. For example, it would be useful to quantify how the consequences of a four-minute response time differ from the consequences of a five-minute response time in the case of a house fire.

Even with all of the best possible information, the challenge remains to develop public policies, traffic calming practices, and emergency response strategies that strike a balance

between the desire for slower and safer traffic conditions and the desire for prompt emergency response.

The research did not identify the cues that the drivers used to select the speeds at which they desired to negotiate each calming device tested.

While attempting to evaluate the affect that traffic-calming devices have on fire vehicle response times, the Portland Fire Bureau evaluated a variety of fire apparatus. The apparatus tested represented the types of fire apparatus currently used by the Portland Fire Bureau to provide public safety to the citizens of Portland. A limitation of the research was that there might be other fire apparatus available to the Portland Fire Bureau that would produce significantly different travel times if they were subjected to the same travel time tests. In addition to testing other fire apparatus models, vehicle modifications of the apparatus tested might have affected the test results.

Another limitation of the research conducted had to do with the length of the street segments evaluated. The street segments tested were relatively short in comparison to the overall distance normally traveled by fire vehicles when responding to emergencies. There was no evaluation of how other traffic modification devices, such as Opticom, affect overall response times. Giving emergency vehicles preferential service at signalized intersections by using traffic signal preemption devices appears to be a way to mitigate or possibly improve response times to traffic calming project areas, although no tests were conducted.

The speed calming devices studied in this research were relatively simple and unsophisticated. Research should continue to expand into new designs, material, and technologies that might lead to effective calming devices that do not delay fire vehicles.

The research was conducted under the assumption that the City of Portland is committed to utilizing traffic calming as a way to reduce the volume and speeds of traffic in neighborhoods.

RESULTS

The results of the research and are presented in Appendix A.

Answers to Research Questions

Research Question 1. The City of Portland is committed to providing a transportation system that both protects the safety and livability of residential neighborhoods and responds to emergency service needs. Unfortunately, some local neighborhood streets experience excessive speeds and traffic volumes. The problem of excessive speeds and traffic volumes is attributable to two main factors. First, although a grid of streets serves much of the city, there are a limited number of through streets. When these streets become congested, traffic diverts to local, neighborhood streets. Second, a number of local streets are wide and straight. This design invites traffic to travel at greater than posted speeds. In response to resident complaints, the City initiated a traffic-calming program. The program uses education, enforcement, and engineering to address these problems.

At the 1998 International Institute of Transportation Engineers (ITE) annual conference in Toronto, Canada, Reid Ewing offered a definition that best describes the public's desire for traffic calming. He defined traffic calming as:

> "Traffic calming involves changes in street alignment, installation of barriers, and other physical measures to reduce traffic speeds and/or cut-through volumes, in the interest of street safety, livability, and other purposes."

Along with increasing public safety, traffic calming is most often touted as a way to increase or enhance livability in neighborhoods. Livability is one of those terms that is nearly impossible to define, as the definition will vary greatly depending on the individual and their values. However, some success in quantifying livability as it relates to traffic has been achieved through the 1972 research of Donald Appleyard. Donald Appleyard looked at the environmental quality of city streets in San Francisco, California. The findings of his study are that residents are more satisfied with the street environment when traffic volumes and speeds are low to moderate. He found that residents are more likely to walk, bike, and play along such streets, and there is a greater sense of community. Appleyard concluded in his book *Livable Streets*:

> "The environmental capacity of most residential streets might therefore be reached in the 500 to 800 vehicles per day range. The speed of drivers must also be considered. Speed limits for the top 15 percent should be in the 15 to 20 mph range for children."

A recent report on the benefits, costs and equity impacts of traffic calming (Litman, 1997) found that communities that reduce automobile dependency tend to have roadway design features associated with traffic calming such as traffic speed and volume constraints, pedestrian friendly street environments, and higher density commercial and residential patterns. The report states:

> "…Traffic calming can help reduce low density urban expansion (urban sprawl) by improving urban environmental quality, thus reducing the incentive for residents to move to suburban areas, although it's impact on the complex social forces contributing to sprawl are limited."

In a 1980 study conducted by Gordon Bagvy, he found that homes in a neighborhood with traffic restraints (traffic calming) had an average value 18% higher than comparable homes in a neighborhood without such restraints, and this increment appears to increase over time.

Research Question 2. The purpose of this research was to show how speed bumps and traffic circles affect fire vehicle travel times. The results of the City's research are presented in the tables listed below:

Table 1

Typical Impacts of Traffic Circles on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	14	25	2.8	261
	14	30	4.3	489
	14	35	6.1	671
	14	40	8.5	814
Rescue 41	16	25	1.3	170
	16	30	2.3	301
	16	35	3.1	467
	16	40	5.1	612
Squad 1	17	25	1.2	172
	17	30	2.3	326
	17	35	3.7	501
	17	40	5.3	776
Truck 1	10	25	4.8	319
	10	30	6.4	524
	10	35	8.4	749
	10	40	10.7	1034
Truck 4	11	25	4.3	322
	11	30	6.2	549
	11	35	8.1	799
	11	40	10.3	1139
Truck 41	11	25	3.9	338
	11	30	5.2	555
	11	35	7.3	845
	11	40	9.2	1255

Lowest Speed: This is the lowest speed a vehicle travels when navigating around a traffic circle.

Desirable Speed: This is the speed a driver might wish to travel if there were no traffic circles.

Travel Time Delay: This is the additional time required to travel to a destination due to a traffic circle's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at the desired speed because of the traffic circle's influence.

Table 2

Typical Impacts of 14-foot Speed Bumps on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	13	25	2.3	236
	13	30	3.7	399
	13	35	5.2	581
	13	40	7.7	814
Rescue 41	17	25	1.0	147
	17	30	1.7	269
	17	35	2.9	483
	17	40	4.9	628
Squad 1	12	25	2.7	244
	12	30	4.1	436
	12	35	5.9	611
	12	40	8.3	852
Truck 1	11	25	3.4	269
	11	30	4.9	455
	11	35	6.6	646
	11	40	9.4	931
Truck 4	12	25	3.4	315
	12	30	4.9	485
	12	35	6.8	732
	12	40	9.1	1053
Truck 41	12	25	3.5	327
	12	30	4.7	472
	12	35	6.6	762
	12	40	8.6	1152

Lowest Speed: This is the lowest speed a vehicle travels when navigating around a traffic circle.

Desirable Speed: This is the speed a driver might wish to travel if there were no traffic circles.

Travel Time Delay: This is the additional time required to travel to a destination due to a traffic circle's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at the desired speed because of the traffic circle's influence.

Table 3

Typical Impacts of 22-foot Speed Bumps on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	21	25	0.8	136
	21	30	1.7	323
	21	35	3.0	505
	21	40	5.0	752
Rescue 41	34	25	0.0	0
	34	30	0.0	0
	34	35	0.3	118
	34	40	1.5	263
Squad 1	24	25	0.4	80
	24	30	1.0	214
	24	35	2.1	433
	24	40	3.4	708
Truck 1	22	25	0.6	137
	22	30	1.4	320
	22	35	3.0	600
	22	40	4.9	885
Truck 4	16	25	1.8	254
	16	30	3.4	449
	16	35	5.9	674
	16	40	7.7	1039
Truck 41	14	25	3.0	316
	14	30	4.8	622
	14	35	7.2	912
	14	40	9.2	1322

Lowest Speed: This is the lowest speed a vehicle travels when navigating around a traffic circle.

Desirable Speed: This is the speed a driver might wish to travel if there were no traffic circles.

Travel Time Delay: This is the additional time required to travel to a destination due to a traffic circle's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at the desired speed because of the traffic circle's influence.

As mentioned earlier, the testing considered four variables that influence the speed at which a fire vehicle can be negotiated around traffic circles or across speed bumps. The variables tested were the driver, the type of fire vehicle, the desirable speed, and the types of calming devices. Depending on the type of fire vehicle and the desirable response speed, the three devices were found to create the following range of delay per device:

- 14-foot speed bumps create 1.0 to 9.4 seconds of delay per bump
- 22-foot speed bumps create 1.0 to 9.4 seconds of delay per bump
- traffic circles created 1.3 to 10.7 seconds of delay per circle

The drivers' performances did not appear to significantly influence the results. Their choices of deceleration and acceleration rates as well as their choices of minimum speeds near the devices were very consistent.

Table 4

March 11 and 12, 1991 Fire Bureau Speed Bump Test

Portland Fire Bureau Vehicles Tested:	
Engine 25	Speeds up to 20mph were tolerable. At 25 mph vehicle bounces considerably with dislodging of equipment in compartments. Driver and Officer recommended against testing at higher speeds.
Truck 25	Speeds up to 20 mph were tolerable. At 25 mph vehicle bounces considerably with rear

	wheels leaving the ground, dislodging equipment in compartments. Driver and Officer recommended against testing at higher speeds.
Rescue 25	Speeds up to 30 mph were tolerable, no further testing indicated.
Truck 1	Speeds up to 20 mph were tolerable. At 25-mph vehicle rear platform bounces considerably, equipment in compartments dislodged. Driver and Operator recommended against testing at higher speeds.
Hazardous Materials 7	Speeds up to 30 mph were tolerable, no further testing indicated.
Portland Police Bureau	The Portland Police Bureau reported that the patrol car and motorcycle experienced no problems with the speed bump.
Buck Medical Service	AT 27 mph, a person sitting in the back of the ambulance or on the stretcher would experience severe and unacceptable movements. Speed bumps should not be installed on major thorough streets.
City of Portland Maintenance Bureau	Speed bumps should not be installed on designated snow/ice routes or bus routes.
Bicyclists	Appeared to be unaffected by the speed bump.

Research Question 3.

In addition to the type of traffic calming device used to treat a section of roadway, there are other variables that affect vehicle travel times. As shown in the tables above, the type of emergency vehicle used can have a significant affect on vehicle travel times.

Street design can also play a part in determining overall travel time. Narrow streets, or streets with steep inclines have proven to negatively affect the travel time of emergency response apparatus. Vehicles parked too close to traffic circles were found to dramatically impact the travel time of emergency response vehicles. In some cases, cars parked too close to the traffic circle actually prevented the larger fire apparatus from negotiating around the traffic circle.

At the beginning of the research, it was thought that human ability would have a significant affect on overall fire vehicle response times. For this reason, twelve different vehicle operators were selected to participate in the driving tests. Each of these vehicle operators were trained firefighters familiar with the particular vehicles that they drove during the field tests. The driver's performance did not appear to significantly influence the results. Their choices of deceleration and acceleration rates as well as their choices of minimum speeds near the devices were very consistent.

DISCUSSION

Traffic calming is intended to reduce speed and traffic volume, primarily on residential streets. This is done by a variety of techniques, including speed bumps, traffic circles, narrowing lanes, restricting turns, and diverting traffic. Studies do tend to show that traffic calming can reduce vehicle accidents and increase safety for pedestrians and bicyclists (EWG, 1997).

In the City of Portland, excessive traffic speeds and volumes have been consistently cited by residents as one of the greatest threats to feeling comfortable and safe. In a 1992 City of Portland Citizens Advisory Committee Report evaluating the Neighborhood Traffic Management Program, 37 percent of the people surveyed indicated "people driving too fast in neighborhoods was the single most serious traffic safety problem.

The data gathered by the City of Portland and presented in Tables 1, 2, 3 and 4 of this report confirm that fire vehicle response times are negatively affected when traffic-calming devices are installed on neighborhood streets that must be used for emergency response. It was found that the effect of traffic calming on emergency response depends on both the types of claming device and the emergency vehicle used. As noted in Tables 1, 2, 3 and 4 of this report,

the affects of traffic calming on fire vehicle travel times is dependent on many variables. Some of the variables identified were the driver of the vehicle, the type of fire vehicle, the desirable vehicle speed, and the type of calming device.

Police and ambulance providers have not expressed as much concern about the effects of traffic calming on their response (Table 4).

This researcher found it very difficult to validate or compare the results of the City of Portland's research given that no other similar studies could be found. While comparison data was unavailable, this researcher is convinced of the need to develop a comprehensive traffic management plan that addresses both the public's desire to reduce traffic volumes and speeds in their neighborhoods and the need to maintain acceptable response times for public safety providers.

The trade-off appears to be clear. On one hand, we must manage the increased use of cars to preserve the quiet and safe neighborhood quality often associated with the "livability" of Portland. On the other hand, we must assure public safety concerns are addressed.

RECOMMENDATIONS

The influences of traffic calming devices on fire vehicle travel times is becoming very important to those of use charged with providing public safety services. The challenge for elected officials and public service leaders alike, is the challenge of developing public policies, traffic calming practices, and emergency response strategies that strike a balance between the desire for slower and safer traffic conditions and the desire for prompt emergency response.

The City of Portland is committed to providing a transportation system that both protects the safety and livability of residential neighborhoods and responds to emergency service needs.

Elected officials across the country are also beginning to respond to their citizen's request for traffic calming. Depending on the policies and traffic calming practices adopted, public safety providers are finding it more and more difficult to maintain acceptable response times. In particular, fire departments will have a difficult time maintaining acceptable response times given that the size and type of vehicle used are in most instances much larger that the vehicles used by other public safety providers.

The results of the field studies conducted by the City of Portland provided data that can be used to determine the impacts of traffic calming devices on fire response times along a given emergency response route. While this information is obviously useful for planning and designing individual traffic calming projects, additional information is necessary in order to make a complete assessment of these impacts. Specifically, this includes the types of fire vehicles responding to emergencies; the desirable and appropriate speed of fire vehicles at each of the calming devices located along the response route; the geographical area that will be affected by an increase in delay to response to response times; and the use of this route by fire vehicles given the likely demand for emergency services and the availability of good alternative routes.

In addition, this researcher recommends that decision makers take a full assessment of the impacts on response times for a given set of traffic calming devices and balance this with the benefits of traffic calming on reducing speeding problems and enhancing public safety and livability along neighborhood streets.

As a result of the information reviewed during this study, this researcher recommends that the Portland Fire Bureau should continue their active participation in the development and review of the City of Portland's traffic calming policies. Active participation should include

assigning fire service personnel to work with other city employees to develop a comprehensive traffic management plan that addresses emergency response needs.

The development of a comprehensive traffic management plan that addresses the entire network of city streets will further provide benefits to the Portland Fire Bureau by reducing the need to review traffic calming projects on a case by case basis. Reviewing traffic calming devices on a case by case bases has been very time consuming, and may not provide the most effective network of streets for the public. The development of a traffic management plan that addresses the concerns of public safety providers as they relate to acceptable response times, will allow the City of Portland to look years into the future as it prepares to deal with growth and livability.

This researcher recommends that the Fire Bureau, working with representatives of the Department of Transportation, develop an Emergency Response Classification Map. This map should divide city streets into two distinctly different categories: 1) Major Response Streets, and 2) Minor Response Streets. Major Response Streets should not be eligible for slowing devices, while Minor Emergency Response Streets would be eligible for slowing devices.

It is recommended that future Executive Fire Officer students continue researching this topic as it is becoming a common concern for fire service providers across the country.

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APPENDIX A

In response to the high demand for traffic calming projects and the potential for delay in emergency response delivery, the Portland City Council took action to resolve this conflict. In April 1996, Council directed the Office of Transportation and the Fire Bureau to resolve this problem through a policy approach. Staff was directed to develop a new emergency response policy and street classification system for incorporation into the Transportation Element of the City's Comprehensive Plan.

Having policy language on emergency response, accompanied by an emergency response classification system is beneficial for several reasons.

- First, it balances the need for prompt emergency response with the need for slowing traffic on residential streets.
- Second, it provides the City and its residents with clarity and certainty regarding streets' eligibility for traffic slowing devices.
- Third, it ensures a basic network of emergency response streets. This network can be used to help route response vehicles in an emergency and to help the City site future fire stations.
- Fourth, it will be incorporated into the City's Transportation Element. This allows emergency response needs to be considered with other needs when changes to a street are considered.

With the help of a Citizen Advisory Committee, the Fire Bureau and the Department of Transportation developed a resolution that directs both bureaus to use the policies listed above when determining a street's eligibility for traffic slowing devices, to

help plan improvements and site fire stations, and to guide the routing of emergency response vehicles. This resolution was adopted by City Council on April 1, 1998.

APPENDIX B
CITY COUNCIL RESOLUTION

RESOLUTION No. 35683

Accept the Emergency Response Classification Study Report and Recommendations and Emergency Response Streets map (Resolution).

WHEREAS, the City is committed to providing a transportation system which both protects the safety and livability of residential neighborhoods and responds to emergency service needs; and

WHEREAS, the Traffic Calming Program works to reduce traffic speeds on local and neighborhood collector residential streets; and

WHEREAS, the Fire Bureau works to respond to emergencies as quickly as possible; and

WHEREAS, certain traffic calming devices installed to slow general traffic also slow emergency response vehicles; and

WHEREAS, on April 2, 1996 the Fire Chief and Bureau Director of Traffic Management presented a joint proposal to Council to resolve this issue by developing a new emergency response street classification for incorporation into the Transportation Element of the Comprehensive Plan; and

WHEREAS, on April 2, 1996 Council directed staff to resolve this matter as proposed; and

WHEREAS, Commissioners Hales and Kafoury appointed a Citizen Advisory Committee to work with staff in resolving this issue, and

WHEREAS, the project held three public open houses to present proposed recommendations to City Council;

NOW, THEREFORE, BE IT RESOLVED that this resolution will provide operating guidelines for the Office of Transportation and the Fire Bureau until adoption of these policies by ordinance into the Transportation System Plan.

Adopted by the Council, April 01, 1998
Commissioner Charlie Hales
Monique Wahba
April 1, 1998

Barbara Clark
Auditor of the City of Portland